299-E28-7 (A4827)

Log Data Report

Borehole Information:

Borehole:	299-E28-7 (A4827)		Site:	216-B-5 Injection Well	
Coordinates		GWL (ft)[1]: 288.32		GWL Date:	10/10/01
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
136719	573794	April 1948	685.91 ft	338	

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Steel Welded	25.25"	8.625	7.875	0.375	0	217.0
Steel Welded	25.25"	6.688	6.063	0.3125	0	340.0

Borehole Notes:

The logging engineer measured the pipe stickup at the borehole using a steel tape. The logging engineer reported that it was difficult to measure the casing thicknesses with calipers due to the casing configuration. The outside diameter of the 6 11/16-in. casing was obtained using a tape measure. The inside diameter of both strings of casing was calculated.

Casing configuration information was obtained from the well construction and completion summary in Ledgerwood (1992). The 8-in. nominal casing extends from the ground surface to 217 ft while the 6-in. nominal casing extends to 338 ft. The 8-in. nominal casing was perforated from 0 to 100 ft, and the annulus between the casings was grouted with 300 gallons of cement in 1979. The 6-in. nominal casing was perforated from 270 to 335 ft with 2 cuts/round.

Logging Equipment Information:

Logging System:	Gamma 1D	Type:	SGLS (35%)
Calibration Date:	07/01	Calibration Reference:	GJO-2001-243-TAR
		Logging Procedure:	MAC-HGLP 1.6.5

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4	5	6
Date	10/15/01	10/16/01	10/17/01	10/18/01	10/19/01	10/19/01
Logging Engineer	Musial	Musial	Musial	Musial	Musial	Musial
Start Depth (ft)	288	2.5	64.0	224.0	138.0	130.0
Finish Depth (ft)	225.5	65.5	139.0	155.5	156.5	159.0
Count Time (sec)	100	100	100	100	100	100
Live/Real	R	R	R	R	R	R
Shield (Y/N)	n/a[3]	n/a	n/a	n/a	n/a	n/a
MSA Interval (ft)	0.5	0.5	0.5	0.5	0.5	0.5
ft/min	n/a	n/a	n/a	n/a	n/a	n/a
Pre-Verification	A0017CAB	A0018CAB	A0019CAB	A0020CAB	A0021CAB	A0021CAB
Start File	A0017000	A0018000	A0019000	A0020000	A0021000	A0022000

Log Run	1	2	3	4	5	6
Finish File	A0017125	A0018126	A0019150	A0020137	A002137	A002258
Post-Verification	A0017CAA	A0018CAA	A0019CAA	A0020CAA	A0022CAA	A0022CAA
Depth Return Error (in)	0	0	0	-2	n/a	-5.5
Comments						Repeat section

Logging Operation Notes:

Fine-gain adjustments were not necessary during the logging runs. Zero reference is the top of casing.

Analysis Notes:

Analyst:	Sobczyk	Date:	10/31/01	Reference:	MAC-VZCP 1.7.9 Rev. 2

Pre-run and post-run verification spectra for the SGLS were evaluated. The acceptance criteria for field verification of the Gamma 1D logging system are in the process of being established. The photopeak counts per second for the 2614.5-keV, 1461-keV, and 609-keV peaks were consistently lower in the post-run verification spectra when compared to the pre-run verification spectra. Examinations of spectra indicate that the detector appears to have functioned normally during the log runs, and the log data are provisionally accepted, subject to further review and analysis.

Individual spectra were processed in batch mode using APTEC Supervisor. Concentrations were calculated in EXCEL, using parameters determined from analysis of calibration data collected in June 2001. From 0- to 219.5-ft depth, a casing thickness of 0.6875 in. was used to calculate casing corrections. This thickness represents the combined thickness of the nominal 6-in. and 8-in. casings. From 220 ft to the maximum log depth at 288 ft, a casing thickness of 0.3125 in. was used. These casing thicknesses were consistent with those measured by the logging engineer in the field. The casing configuration was assumed to be a string of 8-in. casing with a thickness of 3/8 in. to a subsurface depth of 219.5 ft (TOC is the zero reference). A correction for water in the borehole and dead time corrections were not needed.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides (^{40}K, ^{238}U, and ^{232}Th), and ^{137}Cs. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Zero reference is the top of the casing. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable activity (MDA) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation.

Sample data shown on the combination plot are from Smith (1980). These sample data were collected when the borehole was deepened in 1979. Because the reference elevation could not be found in Smith (1980), the depths reported by Smith (1980) are assumed to be relative to the TOC. If the reference elevation was ground level, then the sample depths are 2 ft too high as plotted.

Results and Interpretations:

^{137}Cs, which is a man-made radionuclide, was detected in this borehole. A zone of ^{137}Cs contamination was detected at the ground surface (log depth 2.5 and 3.0 ft) with activities ranging from 1.0 to 0.8 pCi/g. ^{137}Cs was intermittently detected near the MDL at 29.5, 110.5, 112.5, 114.5, 142.5, and 241.5 ft. In 1979, sediment samples collected when the borehole was deepened tested up to 1,200 picocuries per gram of

^{137}Cs and 685 picocuries per gram of ^{90}Sr in the interval from 288 to 340 ft (Smith 1980). Logging was terminated above the latest reported groundwater level because of waste management issues, and this interval was not logged.

The behavior of the ^{238}U log suggests that radon may be present inside the borehole casing. Determination of ^{238}U is based on measurement of gamma activity at 609 and/or 1764 keV associated with ^{214}Bi, under the assumption of secular equilibrium in the decay chain. However, ^{214}Bi is also a short-term daughter of ^{222}Rn. When radon is present, ^{214}Bi will tend to "plate" onto the casing wall and will quickly reach equilibrium with ^{222}Rn. Because the additional ^{214}Bi resulting from radon is on the inside of the casing, the effect of the casing correction is to amplify the 609 photopeak relative to the 1764 photopeak. (The magnitude of the casing correction factor decreases with increasing energy, but gamma rays originating inside the casing are not attenuated.) This effect is seen in log runs 2 (2.5 to 65.5 ft), and 6 (130 to 159 ft), and to a lesser extent in runs 4 (224 to 155.5 ft) and 5 (138 to 156.5 ft). The effects of radon appear to be minimal in log runs 1 (288 to 225.5) and 3 (64 to 139 ft). The reason for variations in radon content between log runs on successive days is not known. Variations in radon content in boreholes are probably related to variations in surface weather conditions. Discrepancies in total gamma counts between log runs 2 and 3, and 3 and 5 are also probably related to variations in radon content. Radon daughters such as ^{214}Bi may also "plate" onto the sonde itself. When this occurs, there is a gradual increase in total counts as well as photopeak counts associated with ^{214}Bi and ^{214}Pb. This phenomenon appears to best explain the observed discrepancy in ^{238}U values between run 5 and the repeat section (run 6).

The presence of radon is not an indication of man-made contamination: it is derived from decay of naturally occurring uranium. As a gas, radon moves easily in the subsurface, and concentrations of radon and its associated progeny can change quickly.

In the repeat log, the SGLS generally showed good repeatability except for the 609-keV photopeak. The repeat log run (log run 6) and the original log run (log run 5) were both run on the same day. There was a depth return error of 5.5 in. in the repeat log. The ^{40}K and ^{232}Th concentrations agree well, but ^{238}U shows higher variability. This variation is attributed to the effects of radon.

The only portion of SGLS data that may be useful for lithologic correlations is probably below 219 ft in the interval of single casing. The 100-s counting time is not sufficient for reliable discrimination of natural radionuclides in the double casing above 219 ft, the presence of radon will cause the apparent activities of ^{238}U to be overestimated. The transition from the coarse-grained sediments of the Hanford H1 to the finer grained sediments of the Hanford H2 is not apparent in the ^{40}K log.

The 216-B-5 reverse well is located about 60 ft northwest of 299-E28-7 where alkaline, low-salt, radioactive liquid wastes from B Plant were discharged to groundwater between 1945 and 1947 (Smith 1980). During this period, about 31 million liters of liquid waste containing 80.7 Curies of ^{137}Cs was discharged (Brown and Rupert 1950). Because of waste management issues, MACTEC-ERS is unable to log beneath the water table in this well and all other wells in the 200 Areas. In addition, due to waste management issues, most of the wells near the 216-B-5 injection wells were not sampled for the groundwater program during fiscal year 2000 (PNNL 2001).

The SGLS should be used to log the interval below the current groundwater level (288.5 to 338 ft) in this well and in nearby wells. Logging in the groundwater is essential in fully characterizing the plume associated with the 216-B-5 Reverse Well, which is a representative site for the 200-TW-2 Tank Waste Group Operable Unit (DOE 2000). Both Brown and Rupert (1950) and Smith (1980) constructed detailed maps and geologic cross-sections showing the distribution of gamma-emitting radionuclides in the aquifer. Logging beneath the water table in the vicinity of the 216-B-5 Reverse Well will supply data that are fundamental to determining mobility of ^{137}Cs in groundwater under field conditions. It would also allow direct comparison to data collected over the past fifty years (Brown and Rupert 1950; Smith 1980). The waste generated by SGLS logging is small, and a waste management plan is in place (DOE 2000).

[1] GWL – groundwater level
[2] TOC – top of casing
[3] n/a – not applicable

References:

Brown, R.E. and H.G. Ruppert, 1950. *The Underground Disposal of Liquid Wastes at the Hanford Works, Washington*, HW-17088, General Electric Hanford Company, Richland, Washington.

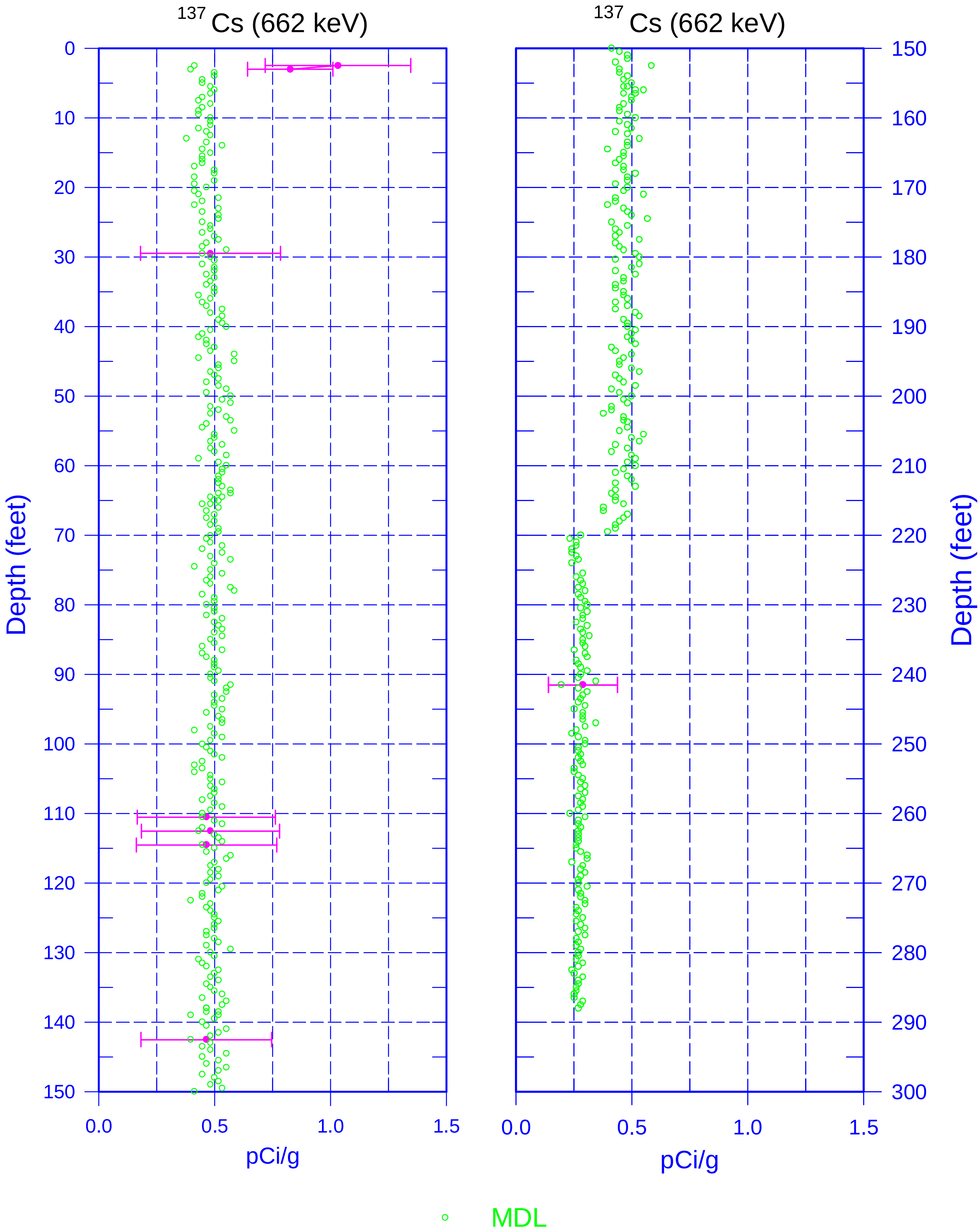
Ledgerwood, R.K., 1992. *Summaries of Well Construction Data and Field Observations for Existing 200-East Aggregate Area Operable Unit Resource Protection Wells*, Draft WHC-SD-ER-T12EAA, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Pacific Northwest National Laboratory (PNNL), 2001. *Hanford Site Groundwater Monitoring for Fiscal Year 2001*, PNNL-13404, Pacific Northwest National Laboratory, Richland, Washington.

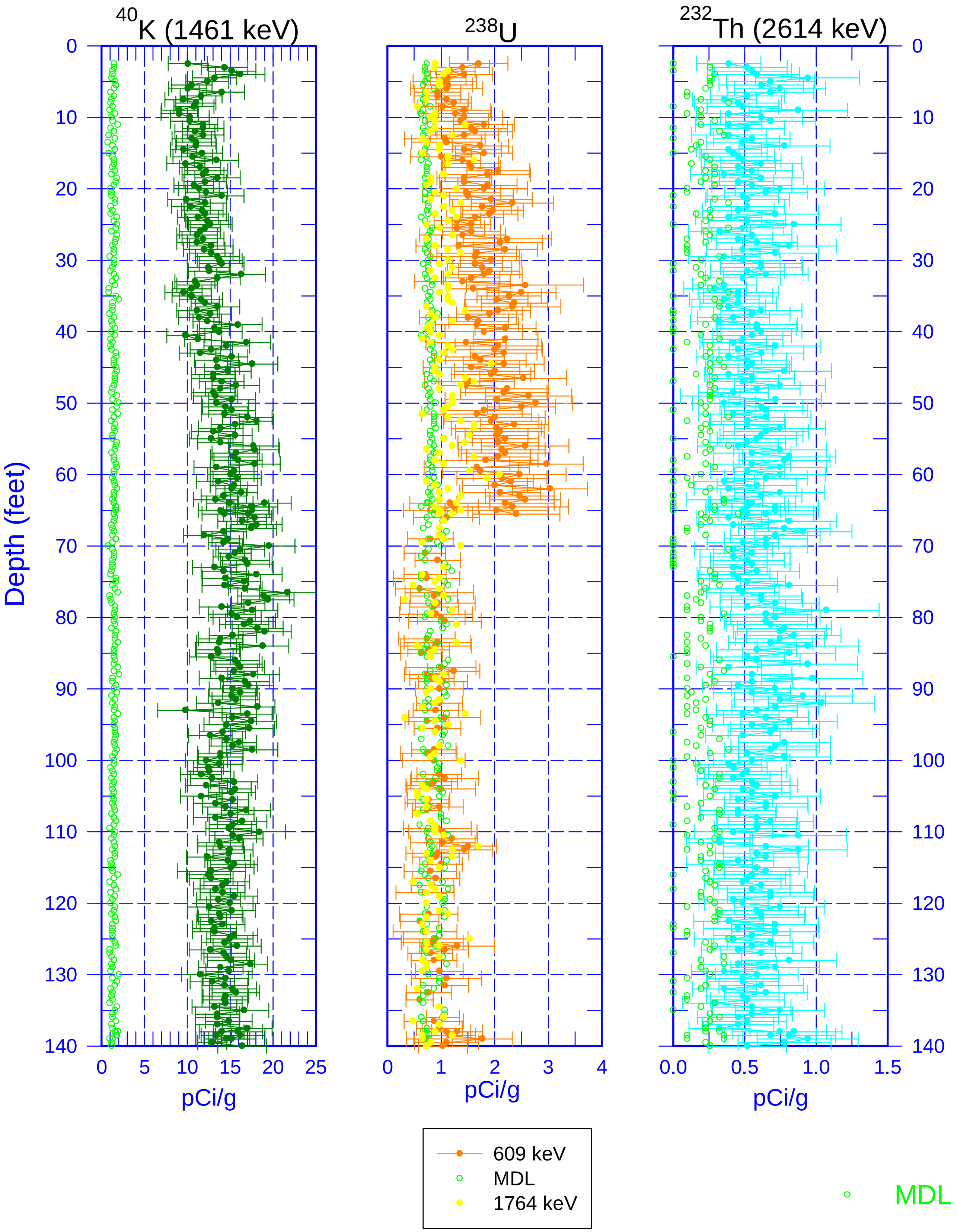
Smith, R.M, 1980. *216-B-5 Reverse Well Characterization Study*, RHO-ST-37, Rockwell Hanford Operations, Richland, Washington.

U.S. Department of Energy (DOE), 2000. *200-TW-1 Scavenged Waste Group Operable Unit and 200-TW-2 Tank Waste Group Operable Unit RI/FS Work Plan*, DOE/RL-2000-38, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

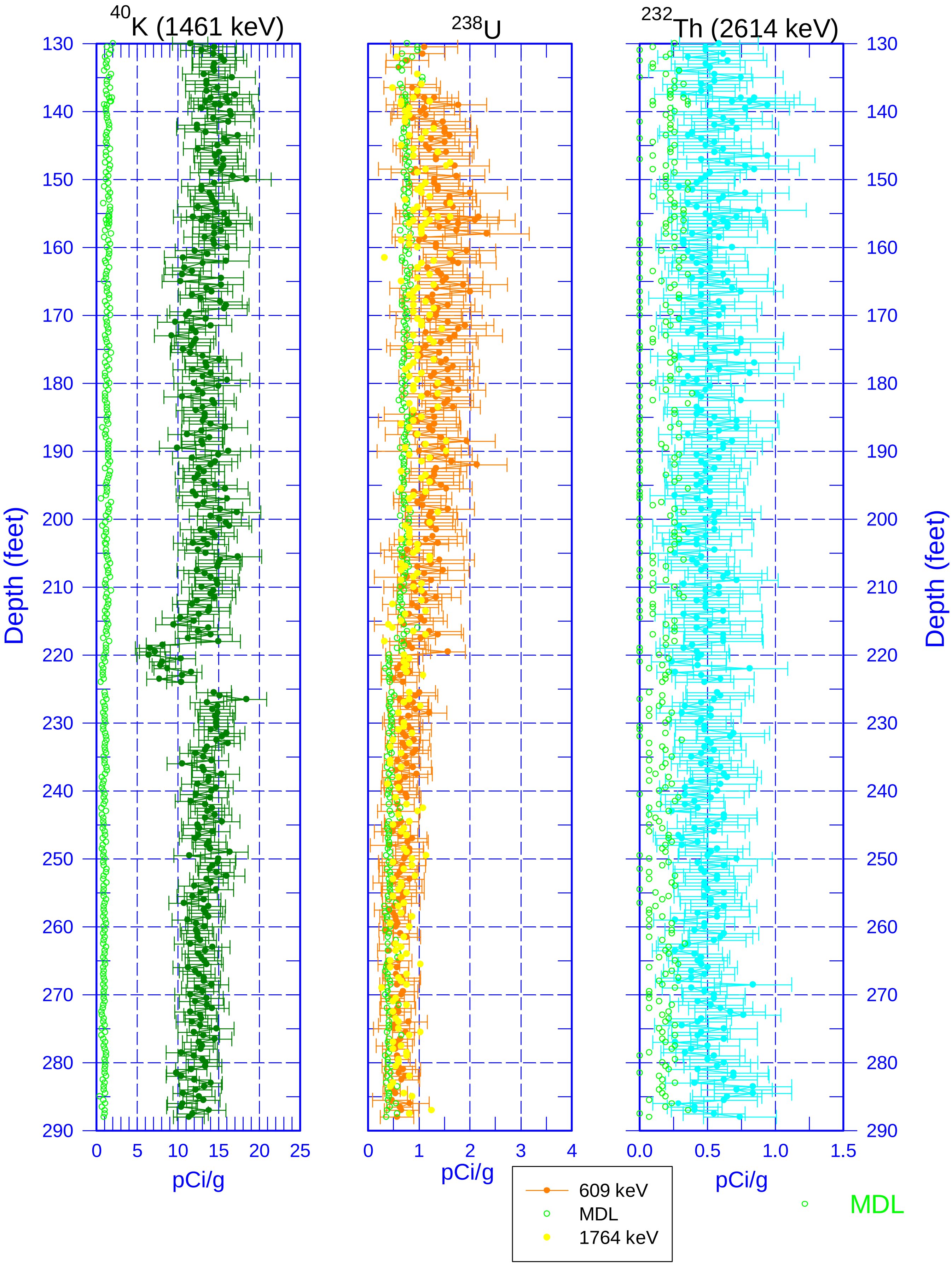
299-E28-7 (A4827)
Man-Made Radionuclide Concentrations



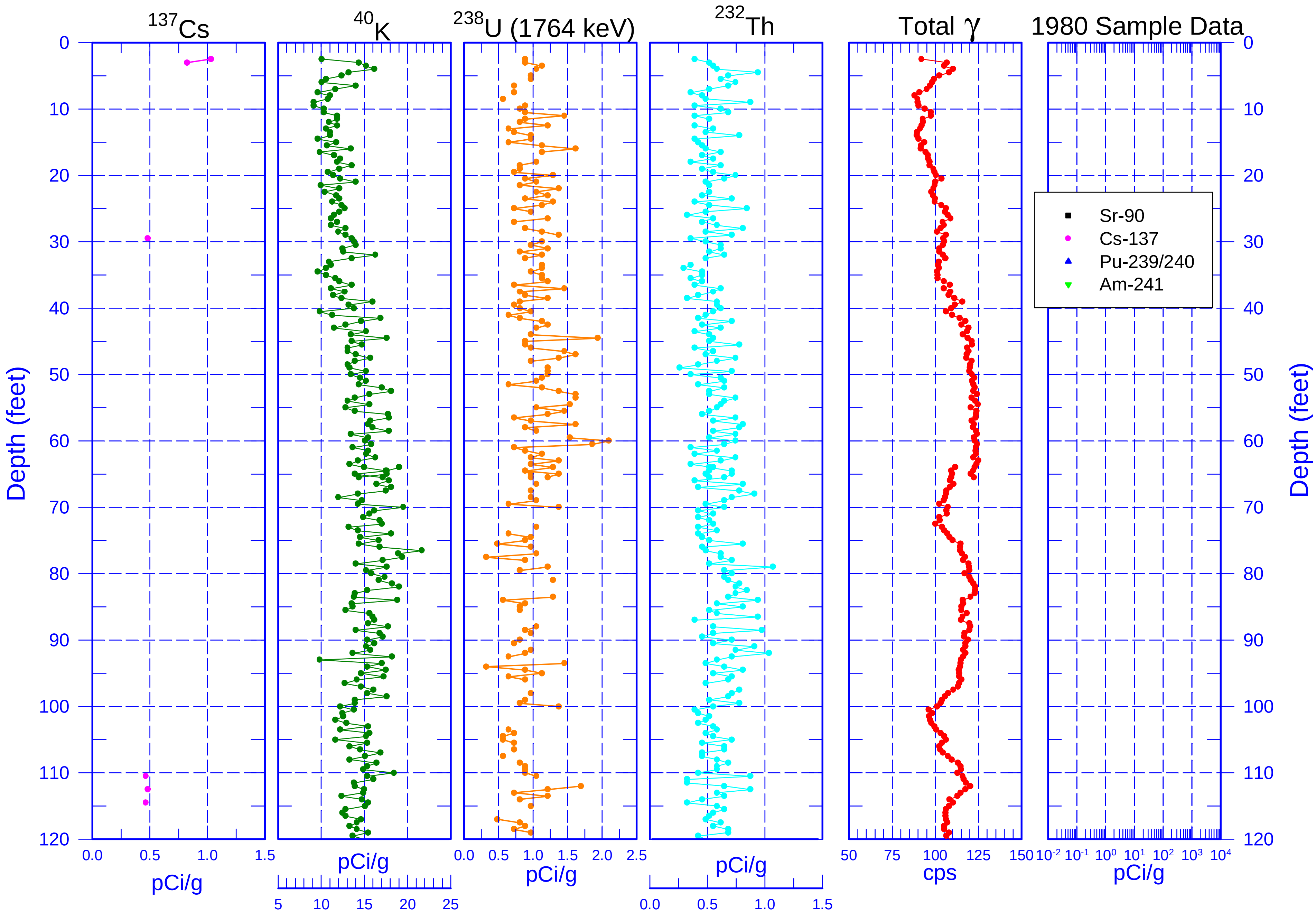
299-E28-7 (A4827)
Natural Gamma Logs



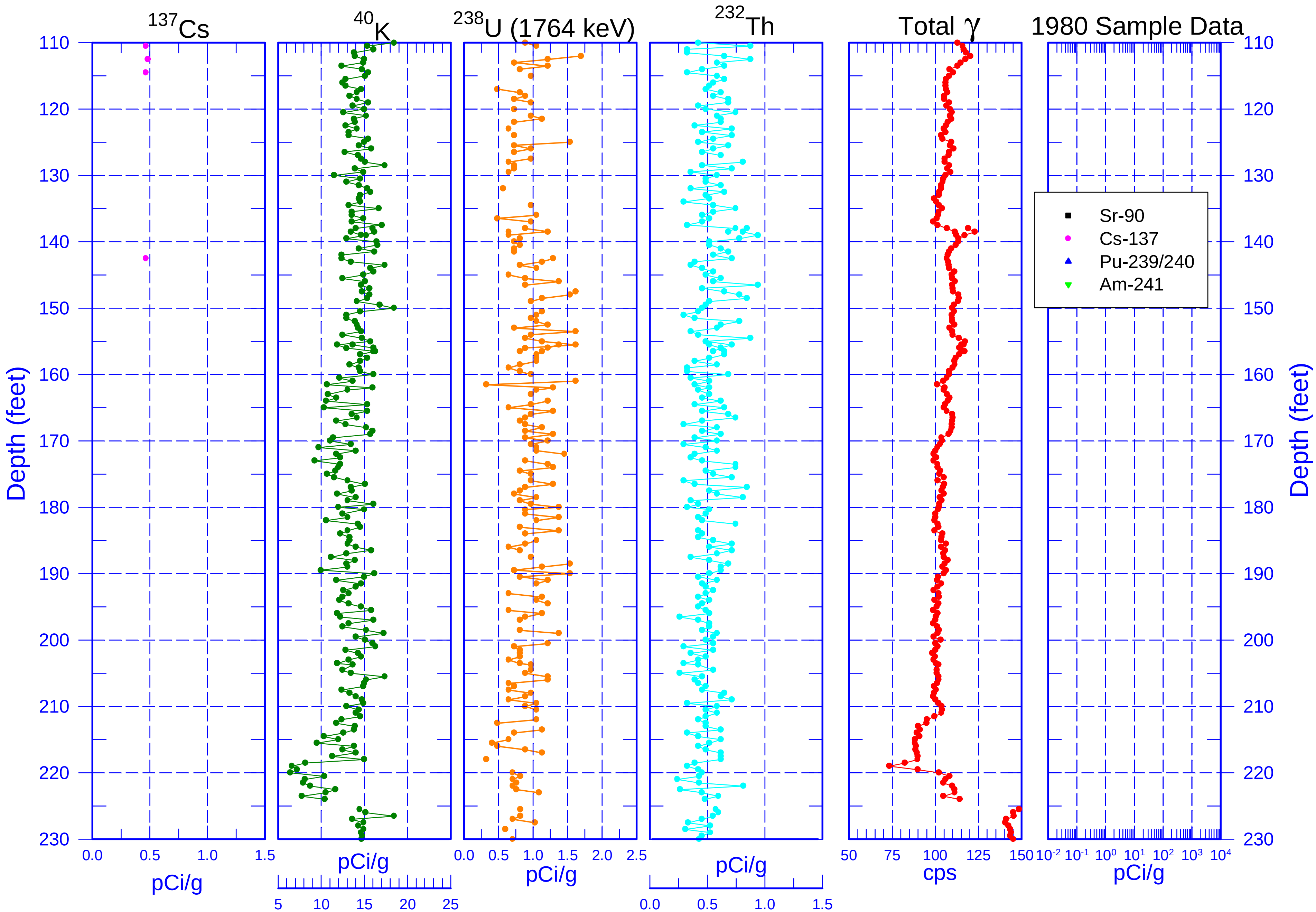
299-E28-7 (A4827)
Natural Gamma Logs



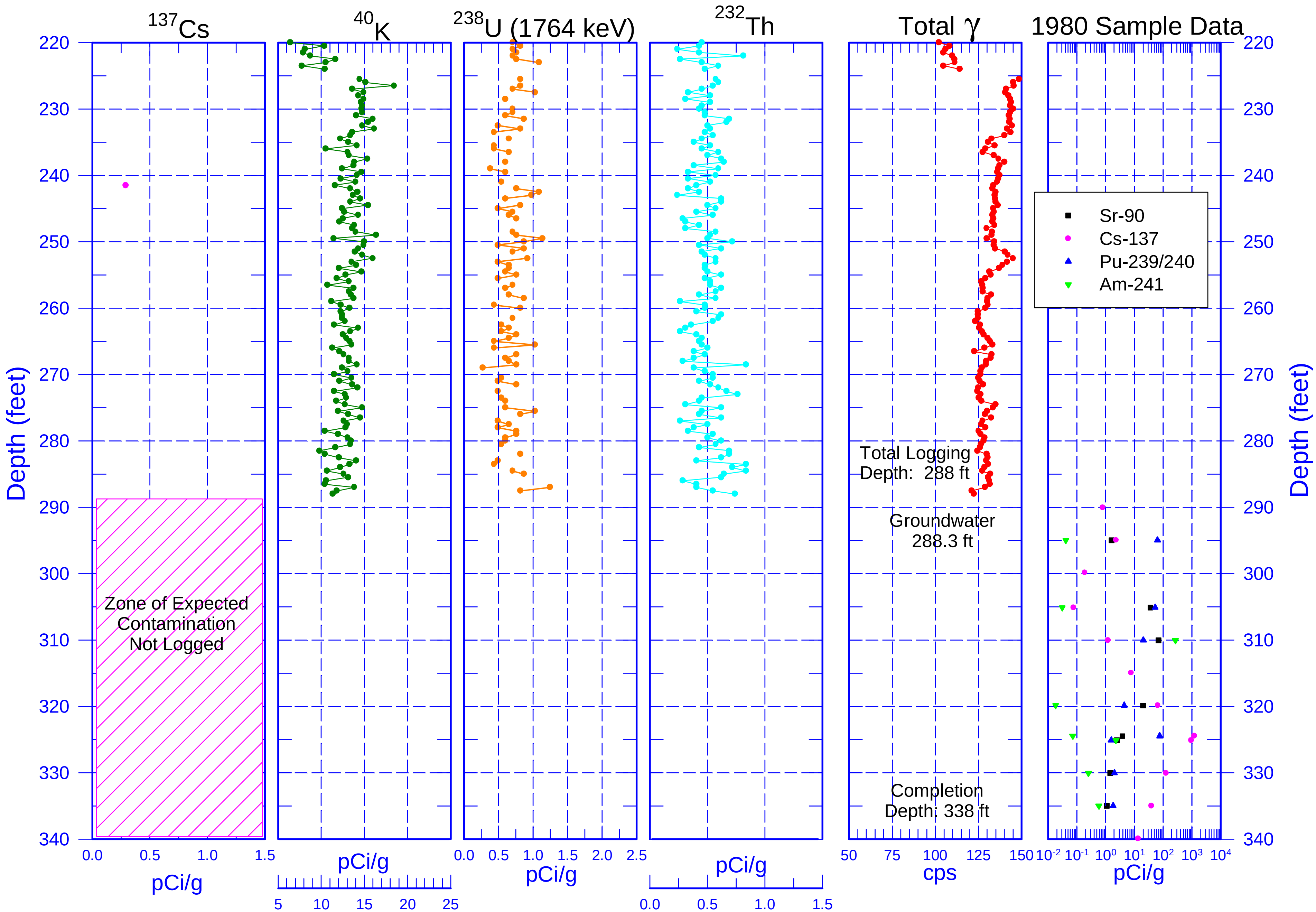
299-E28-7 (A4827) Combination Plot



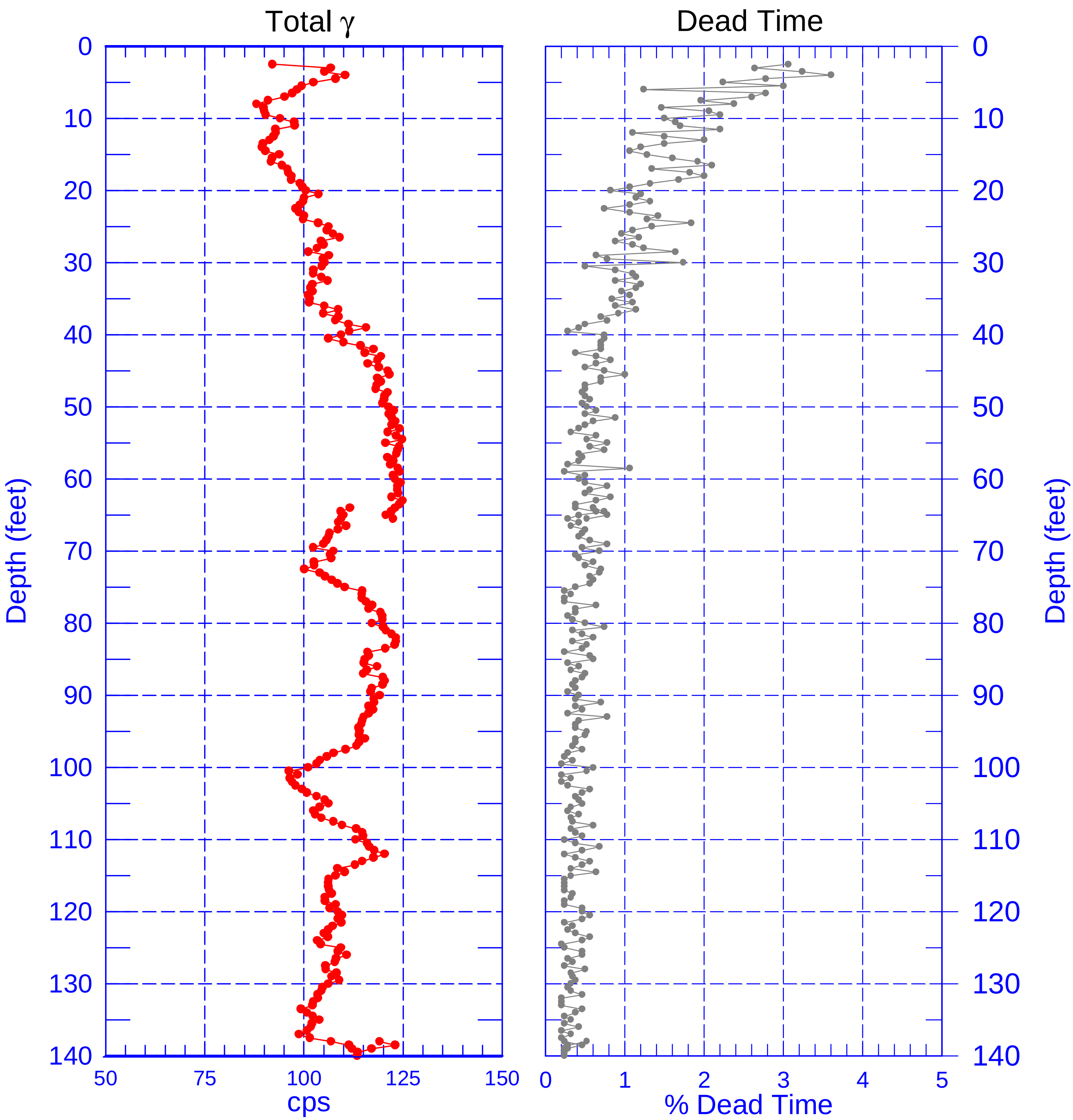
299-E28-7 (A4827) Combination Plot



299-E28-7 (A4827) Combination Plot



299-E28-7 (A4827)
Total Gamma & Dead Time



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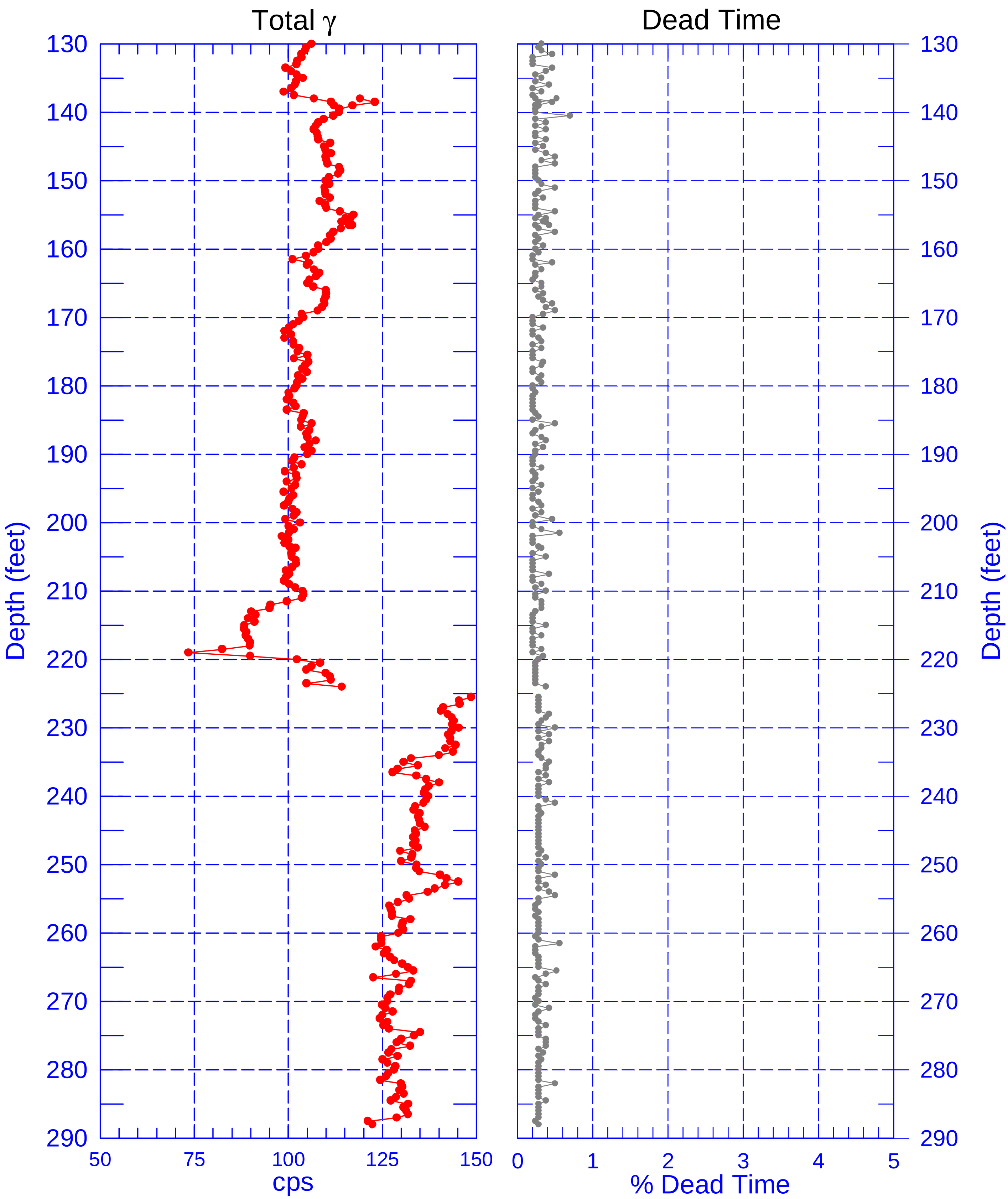
Total Gamma & Dead Time



299-E28-7 (A4827)
Rerun of Natural Gamma Logs